# IoTxx Advanced Details

The IoTxx devices offer many capabilities that require additional explanations to fully utilize.  Because the various models of the IoTxx line vary from inputs-only and outputs-only to combined input/output units, **PLEASE NOTE THAT YOUR SPECIFIC IoTxx MAY NOT SUPPORT ALL FEATURES DISCUSSED IN THIS DOCUMENT.**  It is assumed that the reader has a good understanding of the functionality of the particular IoTxx.  To enable or program some of these advanced features, a PC or Web application such as our Utility Suite needs to be used.

## IoTxx as an Input Controller (Insteon Sender)

In this mode, the IoTxx responds to changes in its inputs, and sends either **group commands** to devices it is linked with, or **broadcast messages** if not linked.  Please note that only one mode may be active at a time.  As a controller, IoTxx has these additional features:

- A timer can be enabled that starts on the Off-to-On (leading edge) input transition and sends the On-to-Off command/message 1 second-255 minutes later.  This is useful as a safeguard in case the input signal does not return to its initial state.  The unit can also be programmed to ignore the physical change of the signal from On-to-Off while the timer is running.
- The commands that are sent on both input signal transitions are programmable.  They default as Insteon On and Off respectively.
- The input can be enabled to directly effect the corresponding relay (actuate local mode)
- An input can be linked as a responder to another Insteon controller to cause a trigger as if a physical signal were present on the input.

The type of inputs can be:
a) **Digital:** responds to the presence or absence of a signal, such as in a switch clo-sure. The signal is ON whenever the switch is closed.
b) **Analog:** responds to a change of value of the signal such as temperature being sensed through a thermistor or other analog sensor.  When the analog conversion is ena-bled, the digital representation of this signal will be ON whenever the signal goes over the preset threshold (alarm point.)

The status of the inputs (both their digital representation and the value of the analog ones) can be read at any time with the appropriate Insteon command (see reverse page.)

**Configuration Register Effect on the Inputs:** If checked, the various bits on this register affect the IoTxx as follows:
- Enable Analog Inputs: Sets up the appropriate inputs to measure discrete values (0-5V or 0-3.3V depending on IoTxx model)
- Continuous A/D Conversion: The analog to digital conversion will occur once per second as opposed to once when the input value is read
- Debounce the Inputs: a noise filter will be applied to signal transitions.  Useful for suppression of "chatter" or noise from relays
- Enable 1-W Sensor:
- Set Timers in Seconds: The input timers unit will be seconds
- Broadcast on Status Change: when the input is not linked, a broadcast message is sent with the input status encoded.



Fig. 1: Configuration Register

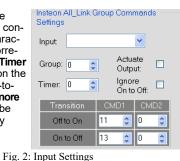**Input All-Link Settings:** All inputs can be set to send commands/messages on their transitions and their behavior can be programmed with the Utility Suite as shown on figure 2.  Note that the Analog and 1-Wire inputs refer to their digital representations, that is, transitions on their alarm points.  When linked, these parameters are used in conjunction with a link record.

A broadcast on an input change can only happen if the input is not linked.  The **Group** number does not need to be the same number as the input, but must match a valid record in the links database.  It is possible that several inputs could have the same group number if one wants to use various inputs to control the same device or device grouping with different characteristics.  The input can have an immediate effect on a corresponding output if the **Actuate Output** box is checked.  A **Timer** value greater than zero (seconds or minutes depending on the control register setting) will determine if an automatic On-to-Off transition is generated automatically.  Finally, if the **Ignore On-to-Off** box is checked, the On-to-Off command will be sent when the timer expires, not when the input physically changes state from On to Off.



Fig. 2: Input Settings

The analog inputs can be "digitized" to provide the Off to On and On to Off transitions at preset points or alarms. These numbers represent a digital count scaled (0-1023) to the input analog values. By having 2 independent values, hysteresis can be built-in.

## IoTxx as an Insteon Responder

In addition to responding to direct commands as shown in the command set table, IoTxx can respond to an All-Link (Group) ON command in different ways as follows:

1. An individual (discrete) relay (output) is turned on
2. A pattern (memorized at the time of linking) is placed on the relays.  This is the so-called "snapshot" mode
3. The IoTxx responds as if one of its inputs goes from off to on.  Think of it as a virtual input, triggerable remotely by an Insteon controller.  If the input has been linked to other Insteon units, a group command would be sent upon this trigger.



Fig. 3: Analog and 1-Wire Alarm Settings

Upon receiving the Group command, the IoTxx uses the middle and lower data bytes from its links record to determine which of the above actions to take according to the table below.
Use the SHN Utility suite or an equivalent program to set the data bytes in the link record per this table, based on the desired behavior.

Relay Timers: If the Enable Output Timers box is checked, the relay will turn off after the timer elapses, even if no additional off command is received.  This feature is useful to create momentary action on the relays as short as 1 second.

| Middle Byte | Lower Byte | Action |
|---|---|---|
| 0x00 | 0x00 - 0x07 | Discrete output (1-8) is activated |
| 0x80 | 0b00000000-0b11111111 (written in hex) | Bit pattern for relays that will be activated and deactivated (1=ON, 0=OFF) |
| 0x81 | 0b00000000-0b11111111 (written in hex) | Bit pattern for relays that will be activated only (1=ON, 0=Not affected) |
| 0x01 | 0x00-0x06 | Discrete input (1-7) is triggered. |

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**X10 Enabling/Disabling:**
- Select the desired House code (A-P) on an X10 controller, then press and hold the Set Button on the side of IoTxx for at least 4 seconds.  The LED will start blinking once the button is released.  Press and hold the button again to stop linking.
- **If enabling** X10 control, send 3 **ON** commands (any Unit code) in succession until the LED stops blinking.  **If disabling**, send 3 **OFF** commands (any Unit code) in succession until the LED stops blinking.

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# IoTxx Insteon and X10 Messages/Commands

The following information is intended to aid in programming a PC application to support our IoT Input/Output devices. The comprehensive Insteon command set was established with and certified by SmartLabs to ensure interoperability and future expansion. Manufacturers of Insteon applications follow this command set to ensure maximum customer satisfaction with Insteon products. In the tables that follow, the column heading **SE DAB** denotes whether the command is Standard-length (**S**) or Extended-length (**E**), and whether it is a Direct (**D**), ALL-Link (**A**), or Broadcast (**B**) command. IoTxx assigned codes by SmartLabs are: DevCat: 0x07, SubDevCat: 0x02. **PLEASE NOTE YOUR SPECIFIC IoTxx MAY NOT SUPPORT ALL COMMANDS.**

## Insteon Standard-Length Direct Messages/Commands

| Command Name | SE DAB | Cmd 1 | Cmd 2 | Description |
|---|---|---|---|---|
| Assign to ALL-Link Group | SD | 0x01 | 0x00 - 0xFF Group Number | Used during Insteon device linking session. Assigns a status snapshot to an ALL-Link group. |
| Delete from ALL-Link Group | SD | 0x02 | 0x00 - 0xFF Group Number | Used during unlinking session. Deletes a status snapshot from an ALL-Link group. |
| Product Data Request | SD | 0x03 | 0x00 | IoTxx responds with an Extended-length **Product Data Response** message. |
| Enter Link Mode | SD | 0x09 | 0x00 - 0xFF Group Number | Enters linking mode. Use to add links. |
| Enter Unlink Mode | SD | 0x0A | 0x00 - 0xFF Group Number | Enters unlinking mode. Use to delete links. |
| ID Request | SD | 0x10 | 0x00 | IoTxx first returns an ACK message, then it sends a *SET Button Pressed* Broadcast message, but it does not enter Linking Mode. |
| Set Address MSB | SD | 0x28 | 0x00—0xFF High byte of 16-bit address | Set Most-significant byte of EEPROM address for peek or poke. Set to 0x00 for access to IoTxx. |
| Poke (see note 2) | SD | 0x29 | 0x00 - 0xFF value of parameter to store | Puts the byte in Cmd 2 into the parameter **RAM** location pointed to by PARPTR . |
| Peek (see note 1) | SD | 0x2B | 0x00 - 0xFF PARPTR value | Sets Cmd 2 value into PARPTR. Cmd 2 of the ACK message returns the byte pointed to by PARPTR. |
| Output ON | SD | 45 | 0x00—0x07 Output number | Turn ON output specified in Cmd2 |
| Output OFF | SD | 46 | 0x00—0x07 Output number | Turn OFF output specified in Cmd2 |
| Write Output Port | SD | 0x48 | 0x00-0xFF Value to store on data register (only output bits are affected) | ACK Cmd2 byte contains the data byte as written to the output port |
| Read Input Port | SD | 0x49 | 0x00 | ACK Cmd2 byte contains the data byte as read from the input port |
| Get Sensor Value | SD | 0x4A | 0x00 - 0x03 Sensor Number | ACK contains sensor value in Command 2. |
| Set Sensor 1 OFF -> ON Alarm | SD | 0x4B | 0x00—0xFF Alarm value | Set value for Sensor 1 to trigger an alarm when its state goes from OFF to ON. |
| Set Sensor 1 ON -> OFF Alarm | SD | 0x4C | 0x00—0xFF Alarm value | Set value for Sensor 1 to trigger an alarm when its state goes from ON to OFF. |
| Write Configuration Port | SD | 0x4D | **Bits 0:7** See Note 1 | Configure IoTxx options. ACK Cmd2 byte contains the new Configuration byte (see Note 1.) |
| Read Configuration Port | SD | 0x4E | 0x00 | ACK Cmd2 byte contains the new Configuration byte. |
| IoTxx Control | SD | 0x4F | Subcommand | |
| | | | 0x00 Load Initialization Values | Resets IoTxx to its factory default settings |
| | | | 0x01 Update EEPROM | Load EEPROM from RAM Parameters |
| | | | 0x02 Status Request | Return the Status of the Outputs in Cmd2 of ACK message |
| | | | 0x05 Get Firmware Version | Reads device firmware version |
| | | | 0x06 Get Output Timers | Read output timers values |
| | | | 0x09 Enable status change message | Enables Output Port status change broadcast messages |
| | | | 0x0A Disable status change message | Disables Output Port status change broadcast messages |
| | | | 0x0E Diagnostics ON | Put unit in Diagnostics mode (cycle outputs 1 sec each) |
| | | | 0x0F Diagnostics OFF | Take unit out of Diagnostics mode |

## Insteon Extended-Length Direct Messages/Commands

| Command Name | SE DAB | Cmd 1 | Cmd 2 | Description |
|---|---|---|---|---|
| Product Data Response | ED | 0x03 | 0x00 | Response to Standard-Length Product Data Request. See Note . |
| Set Sensor/Analog Alarms | ED | 0x4B | 0x00-0x03 Sensor / Analog Input Number | D1—D4 Alarm Values (2 bytes for S1-S4) or 4 bytes for AN1 - AN3 |
| Set Output Timers | ED | 0x4D | 0x00 | D1—D8 Timer Values |
| Get Output Timers Response | ED | 0x4F | 0x06 | Response to Get Output Timers Request D1-D8 Output Timer Values |

## Insteon Standard-Length ALL-Link Messages/Commands

| Command Name | SE DAB | Cmd 1 | Cmd 2 | Description |
|---|---|---|---|---|
| ALL-Link Activate | SA | 0x11 | 0x00 - 0x0F Group number | Recall and activate ALL-Link state for number in Cmd 2 |

## Insteon Standard-Length Broadcast Messages/Commands

| Command Name | SE DAB | Cmd 1 | Cmd 2 | Description |
|---|---|---|---|---|
| SET Button Pressed Slave | SB | 0x01 | None | Linking Mode as a Slave device |
| Status Changed | SB | 0x27 | IoTxx Output Port if "To Address = xx.yy.00 IoTxx Input Port if "To Address = xx.yy.01" | IoTxx will send this message when there is change of data in its output or input port. Cmd2 has the Output or Input status. The lower byte of the "To Address" in the message indicates if an output (00) or input (01) changed. |

## Notes:

1) **IoTxx Configuration Port:** This port determines how IoTxx responds to the various commands. The information in this port is encoded as shown on the right.

| Bit | Description |
|---|---|
| Bit 0—1: | 00 = Analog Input is not used |
| | 01 = Analog Input used, convert on command |
| | 11 = Analog Input used, convert on fixed interval |
| Bit 2: | If set (1): Send Broadcast on Sensor Alarm |
| Bit 3: | If set (1): Debounce the inputs |
| Bit 4: | If set (1): Enable 1-Wire port |
| Bit 5: | If set (1): Timers are in seconds |
| Bit 6: | If set (1): Enable broadcast of Output and Input port change |
| Bit 7: | If set (1): Enable timers if greater than 0 |

2) **IoTxx Memory Layout:** The range of fixed (EEPROM) and volatile (RAM) locations accessible for Peek and Poke (if applicable) correspond to the map on the right. The "rw" notation indicates whether the location is read only ("r"), or both readable and writeable ("rw") when followed with the "RAM to EEPROM" command. Note that some locations are directly accessible with Standard Direct Commands.
Also note that the MSB of the peek address must be first set to 0x00 for these locations to be accessible.

| Address | Description (r: readable; w: writeable) |
|---|---|
| 0x00—0x07 | Output Timers (rw) |
| 0x08 | X10 House Code (rw) |
| 0x09 | Configuration Port (rw) |
| 0x0A—0x11 | Sensor 1-4 Alarms (4 X 2) (rw) |
| 0x12—0x19 | Analog Inputs 1-2 Alarms (2 X 4) (rw) |
| 0x1A | Inputs to Outputs Crosslink bitmap (rw) |
| 0x1B-0x1F | Reserved (rw) |
| 0x20—3F | Group Command On/Off sequence for I1—I8 (rw) |
| 0x40—0x47 | Group numbers for I1-I8 (rw) |
| 0x48 | Firmware Version (r) |
| 0x49 | EEPROM Loaded flag (r) |
| 0x4A | Output Port Status (r) |
| 0x4B | Input Port Status (r) |
| 0x4C | Analog Data (2 X 2) (r) |
| 0x50 | 1-Wire raw data (r) |
| 0x58—0x5F | Input timers (rw) |

## IoTxx X-10 Commands*

| Command Name | UNIT | CMD | Description |
|---|---|---|---|
| Turn Output ON | 1-8 | ON | Turn Output in UNIT (1-8) ON |
| Turn Output OFF | 1-8 | OFF | Turn Output in UNIT (1-8) OFF |
| Enable Timers | 16 | ON | Enable Output Timers |
| Disable Timers | 16 | OFF | Disable Output Timers |

* if X10 support is available

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